

## Article

# Content Learning System (CLS) Validity and Practicality in Atomic Theory on Project Based Learning (PjBL) with Flipped Classroom For Senior High School In Indonesia

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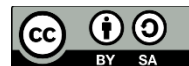
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*Abstract*— With the rapid advancement of technology, it can encourage educators to continue to update the learning media used in transferring knowledge to students. The information re-assets of this have a look at have been three chemistry instructors and college students withinside the town of Padang. The instrument used in the study was a content validity questionnaire and construct validity and a practicality questionnaire. Populations in this research are students from Senior High School in West Sumatera, Indonesia. There are 20 students of SMA N 8 Padang, in X class level as respondents for developing this product. The data analysis technique is to process the numbers that have been obtained from the measurement results of the questionnaire data obtained from calculations using the Aiken's V formula and a Likert scale. The results of the research obtained from the data analysis that have been carried out show that the content of e-learning for the development of atomic theory using the Moodle application produced in this development research has content and construct validity levels of 0.89 and 0.87 with very categories. high and the level of practicality of 0.83 with a very high category. So it can be concluded that the content of e-learning for the development of atomic theory using the Moodle application on the material of atomic theory development is valid and practical.

*Keywords*— **E-Learning, Development of Atomic Theory, Project Based Learning, Flipped Classroom**

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## I. INTRODUCTION

In facing the era of the industrial revolution 4.0. certainl no stranger to the rapid development of technology. This also resulted in the rapid

development of technology in the world of Indonesian education. With the increasingly rapid advancement of technology, of course, it encourages educators to continue to update the

learning media used in transferring knowledge to students. Along with globalization, the current implementation of learning needs to be supported by technology-based learning media. Technology-based media can make students adapt to current developments in the IT field. Students who are accustomed to using IT-based media are indirectly developing their abilities in this field and can develop the quality of their human resources. The use of IT makes the priority of teachers to shape attitudes and characters rather than cognitive intelligence[1, 2]. Learning media is a bridge to convey learning information from teachers to students[3]. The design and selection of appropriate learning media will help students understand the subject matter. Learning media can help facilitate the delivery of material that is less clear to become clearer, so that it is quickly understood by students. The media is also able to deal with the problem of limited space and time[4].

One technology-based learning media that can be used as a support for existing media is in the form of e-learning. There are various types of e-learning such as Moodle, Blackboard, Sakai, dotLRN, Dokeos, and Claroline. Moodle is an implementation event that can renew learning media as a web form. Moodle-based e-learning products allow students to enter "digital classrooms" to access learning materials.

Given the learning indicators that students must master through learning in the classroom are not supported by adequate school time, as well as conventional learning, various efforts are needed to enable the learning process outside school hours, one of which is through learning outside of school hours. school lessons, one of which is through the Flipped classroom learning strategy[5]. Flipped Classroom, is an implementation of a rotational model in where students take turns on a permanent schedule between teacher-led practices (or projects) at school & online post-school content & fees delivery. The application of learning using flipped classroom tactics is effective in increasing the critical intelligence of students. There is a process of relationship between students, teachers and learning environments

that experience changes in behavior, learning outcomes, and intelligence of students [6].

Flipped classrooms "flip" conventional getting to know methods, which incorporates active getting to know, scholar engagement, and podcasting. In flipped study room the fabric is given first thru getting to know movies which college students should watch at their respective homes, at the same time as the getting to know periods in magnificence are used for group discussions and doing assignments, and right here the trainer acts as a facilitator [7]. The distinction among conventional getting to know and Flipped study room is also visible withinside the department of time. Flipped study room permits college students to exercise a lot in magnificence very well due to the fact the getting to know fabric has been given the night before, that is extra time efficient[8]. In the usage of e-getting to know, the flipped study room method is used withinside the getting to know process[9, 10, 11]. Flipped study room is a method that makes use of era that offers extra assisting getting to know substances for college students that may be accessed online[12]. This frees up magnificence time that has formerly been used for getting to know[13,14]. Before face-to-face, college students are requested to take a look at independently at domestic [15,16,17] approximately the fabric for the subsequent meeting, through gaining access to e-getting to know that has been applied through the trainer[18,19,20]. This is supported through studies that has been completed that there's optimization of getting to know with the flipped study room method [21,22,23].

The ideal learning is learning that is student-centered (student centered), students will try to construct their own knowledge and be actively worried in locating information. The implementation of studying, particularly in chemistry subjects, indicates that the fulfillment of cognitive studying effects is ideal but has now no longer hone abilities or different competencies of college students. This may be visible from the participation of college students who're nonetheless passive, the fabric furnished has now no longer been capable of follow information to remedy troubles in actual life,

and there may be no software of studying substances withinside the lives of college students so that scholars are much less innovative and professional and feature a humdrum mindset. So it is not uncommon for chemistry subjects to be less desirable and considered one of the most difficult disciplines of science[24]. Therefore, there is a need for learning to complement the lecture method that can activate students and attract students' interest. As described in (PjBL) PjBL model is progressive getting to know that emphasizes contextual getting to know via complicated sports because of which college students perform assessments to recognize it, emphasizes getting to know the usage of sports that support, assignments given to college students are multidisciplinary, product oriented (artifacts) [25].

The application of PjBL in this learning is an effort to build awareness of the benefits of knowledge. Project primarily based totally getting to know or project-primarily based totally getting to know is an opportunity getting to know that may be used now no longer handiest to evaluate cognitive aspects, however additionally pupil perfProject primarily based totally getting to know or project-primarily based totally getting to know is an opportunity getting to know that may be used now no longer handiest to evaluate cognitive aspects, however additionally pupil performance[26]. This method is quite effective and challenging as a tool to actively teach students because students are encouraged to be more independent, not completely dependent on the teacher, but directed to be able to learn independently[27].

The project based learning (PjBL) learning model provides the opportunity for teachers to manage classroom learning by involving students' project work. This learning is the development of an effective contextual learning because the project-based learning model has the potential to create a more interesting learning experience where students are required to think creatively and can work in teams or groups to shape student creativity and student learning experiences with real projects. Through the

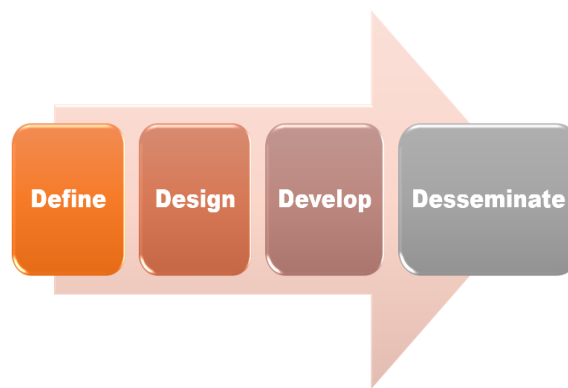
PjBL learning strategy students transfer expertise independently in order that from those sports college students sense worried approximately the surroundings which in flip can shape fantastic attitudes and behaviors toward the surroundings[28,29,30].

Based on these problems, the aim of this study is to develop e-learning content with the flipped classroom approach on the development of atomic theory using the Moodle application.

## II. METHODE

The studies achieved is a form of improvement studies. The motive of this studies & improvement is to broaden new merchandise. The studies layout used is a improvement technique the use of a product withinside the shape of e-getting to know the use of an inverted elegance technique concerning concept improvement the use of the implementation of Moodle.

Research and Development Methods are studies techniques used to make different merchandise and take a look at the effectiveness of those merchandise [31]. The studies layout used the instance of Thiagarajan (4D). The 4D improvement version includes four improvement levels, specifically define, layout, broaden, & disseminate [32]. The levels of 4D improvement are depicted withinside the following figure.



**Figure 1.** Stages of the 4D Model of Thiagarajan Development

The Define Stage is researchers at this stage collect information about the need for e-learning with the flipped classroom approach on the development of atomic theory using the Moodle application on the aspects of student creativity, problems in the process of chemistry teaching and learning activities, the availability of learning facilities, especially ICT-based equipment. The next step is design stage. Researchers in this study carried out the following activities: (1) compiling story boards related to e-learning with the flipped classroom approach on the development of atomic theory using the Moodle application, (2) developing multimedia e-learning chemistry learning with the flipped classroom approach on the development of atomic theory using the Moodle app. The third step is develop stage. The researcher carried out a series of activities, namely: (1) carrying out validation on chemists, (2) carrying out revisions of the validation results of 3 validators, (3) carrying out small / limited-scale trials aimed at determining the implementation of e-learning with the flipped classroom approach on material development of atomic theory using the Moodle application.

This research stage is limited to the develop stage (only validation and practicality). The data sources of this research were 3 chemistry teachers and students at SMAN 8 Padang. The instrument used in the study was a content validity questionnaire and construct validity and a practicality questionnaire.

The data analysis technique is to process the numbers that have been obtained from the measurement results of the questionnaire data to be used as an assessment of material experts and media experts. Furthermore, the data that has been obtained are analyzed to determine the feasibility of the media that has been made. The information received are withinside the shape of qualitative information.

The qualitative information in query is an assessment, criticism, and pointers from media professionals and fabric professionals. In this study, the studies information have been withinside the shape of a percent of the validity score. The percent of validity is received from

calculations the usage of the subsequent Aikens V formula.

$$V = \frac{\sum s}{[n(c-l)]} \dots\dots\dots(1)$$

$$S = r - I_o \dots\dots\dots(2)$$

Description

- Io = the lowest score of validity assessment
- c = the highest score of validity assessment
- r = the score given by the validator
- n = number of validators

The validity category according to *Aiken's V* is presented in Table 1.

**Table 1.** Validity category based on *Aiken's V*

<i>Aiken's V</i> scale	Validity
$V \leq 0,4$	Less valid
$0,4 \geq V \geq 0,8$	Current valid
$0,8 <$	Valid

The variety of numbers V that can be received is among zero to 1. The better the wide variety V (near 1 or same to 1), the better the validity fee of an object / object will be, and the decrease the wide variety V (near zero or same to zero) then the validity fee of an object / object is likewise getting decrease[33].

A practicality questionnaire turned into used to acquire studies facts. The questionnaire includes a practicality questionnaire sheet for instructors and a practicality questionnaire sheet for college students that is used to evaluate problem-based totally learning-primarily primarily based totally totally arithmetic modules. The practicality of the questionnaire sheet became into analyzed descriptively quantitatively. The calculation of the concern reaction facts is calculated based totally at the calculation of the Likert scale score.

$$P = \frac{f}{N} \times 100 \dots\dots\dots(3)$$

Description:

- P: percent of respondents wide variety of solutions from the questionnaire
- f: the entire rating obtained
- N: total best rating for all items.

The practicality category according to *Likert's scale* is presented in Table 2.

**Table 2.** Practicality category based on *Likert's scale*

<i>Aiken's V</i> scale	Practicality
$80\% < x \leq 100\%$	Very Practical
$60\% < x \leq 80\%$	Practical
$40\% < x \leq 60\%$	Practical enough
$20\% < x \leq 40\%$	Less practical
$0\% < x \leq 20\%$	Impractical

### III. RESULT AND DISCUSSION

Based on the research that has been done, the results of each stage of the Thiagarajan (4D) development model have been carried out as follows.

#### A. Defining Stage

##### 1) *Front end analysis*

The front end analysis data came from interviews with chemistry teachers. Based on the results of interviews with chemistry teachers at SMAN 8 Padang, the following results were obtained: (1) the learning model that is usually used is guided discovery learning (2) the teaching materials provided by the school are printed books, worksheets, PPT and learning videos, (3) lack of understanding students in learning use the teaching materials provided.

##### 2) *Student Analysis*

The pupil evaluation degree changed into accomplished with the aid of using interviewing chemistry instructors and sophistication X college students. The ensuing information changed into that scholars have been extra fascinated and prompted to learn while the use of IT-primarily based totally media. Based at the cognitive improvement principle of high college college students from the a while of 15 to 18, which include the formal operational degree[34]. This degree is characterised with the aid of using the capacity to assume randomly, reason logically, and deduce to be had information.

##### 3) *Task Analysis*

Based on the 2013 revision of the 2018 curriculum, the material for the development of atomic theory is found in KD 3.2 and 4.2. From basic competency 3.2, the competency

achievement index is obtained as follows: (1) analyzing Dalton's atomic model, (2) analyzing Thomson's atomic model, (3) analyzing Rutherford's atomic model, (4) analyzing Bohr's atomic model, (5) analyzing atomic mechanics models Quantum. The competency attainment index at KD 4.2 is as follows: (1) describes natural phenomena or the results of experiments using atomic models.

##### 4) *Analysis of Learning Objectives*

Determine learning objectives based on the GPA obtained. The purpose of learning this material is by compiling e-learning content with a computer-based independent learning strategy, students are expected to be able to analyze the development of atomic models from Dalton, Thomson, Rutherford, Bohr, and Wave Mechanics and explain natural phenomena or experimental results using atomic models.

#### B. Design Stage

The activities carried out in this step, namely making designs on the preparation of e-learning electrolyte and non-electrolyte solutions that will be developed. The e-learning arrangement was made using the Microsoft Power Point 2016 application, PicsArt Photo Editor and Logo Maker. This is supported by research that has been done that requires learning that can increase the active role of students and can help students to build their own understanding of chemistry. One such learning is in the form of software [35,36].

Software developed based on the learning process contains two activities, namely activities in class and activities in the laboratory. Research on the development of software-based learning on the subject of buffer solutions shows that the resulting software has good quality based on the assessment of validators and students [37,38,39]. The development of guided inquiry based software on salt hydrolysis material carried out resulted in a high level of validity and very high practicality[40,41].

At the layout stage, there are functions that may be used within the mastering process. These functions consist of the creation of e-mastering covers, the layout of every mastering assembly, the attendance listing of

students, and a area to ship pupil assignments[42,43]. The layout of every assembly is geared up with the coaching substances along side the mastering videos.

## PENGANTAR PEMBELAJARAN KIMIA MATERI PERKEMBANGAN TEORI ATOM



Figure 2. Home Display on E-Learning

In addition, at the design stage there are also several other views such as learning meeting page views, student worksheet assessment views and student worksheets that have been prepared to do exercises as learning evaluation. The view is attached to Figure 2, Figure 3 and Figure 4.



Figure 3. Display Of The Learning Meeting Page

In this e-learning content development, there are also features for each meeting. The features of each meeting depend on the learning material being taught[44,45]. In the material for the development of atomic theory, there are two meetings. This is attached in Figure 3 below.

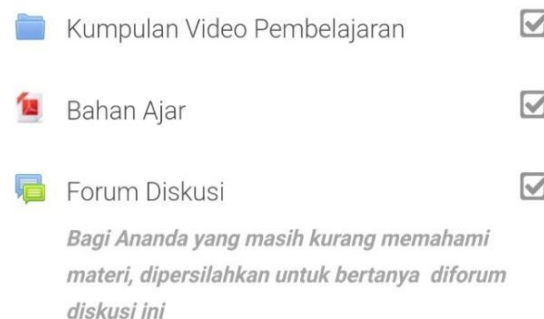


Figure 4. Display Of The Learning Next Meeting Page

### Penilaian Lembar Kerja Peserta Didik

#### Grading summary

Hidden from students	No
Participants	22

Figure 5. Student Worksheet Assessment Views

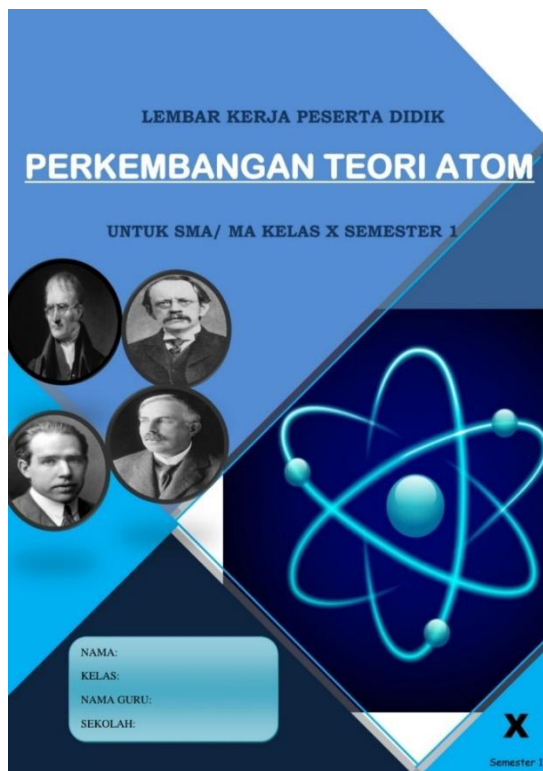


Figure 6. Student Worksheets Cover

In addition to the context on e-learning, there may be content material. The content material consists of exercise questions or quizzes to educate college students in strengthening concepts. In this e-learning, there are 10 questions withinside the shape of more than one choices.



Figure 7. One of the Content on E-Learning

**C. Development Stage**

*1) Validation Test*

The validity test is intended to be able to assess a product. There are two types of validation tests, namely the content validity test and the construct validity. The validation was carried out by 3 chemistry teachers.

The content validity consists of a guide and information component, content / material on e-learning and evaluation. Construct validity also consists of three components, namely information guidance, program performance and systematics, aesthetics and design principles.

The e-learning content designed was assessed by a chemistry teacher. The assessment is based on the statement that testing the validation can use the opinion of experts (judgment experts) which number three people. The results obtained can be seen in Figure 6 and Figure 7.

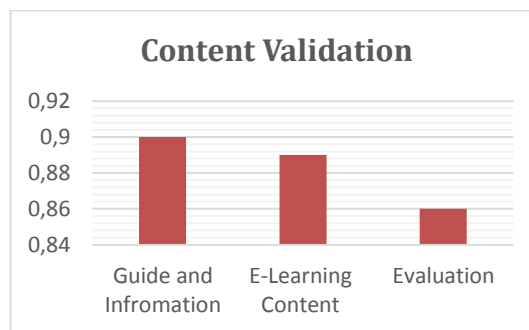


Figure 7. Graph of the Content Validation Results Assessed by the Validator

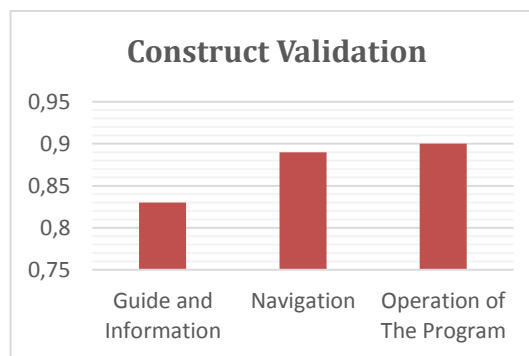


Figure 8. Graph of Construction Validation Results Assessed by the Validator

Overall, the content validity and construction of e-learning learning content for

development materials using the Moodle application developed for each component have high and very high categories respectively, namely 0.89 and 0.87. The results of the validation data show that the content of e-learning for material development of atomic theory using the Moodle application is declared valid and in accordance with the components of the validity assessment[24].

The guide and information components on content validation have an average k value of 0.90, including the very high category. This proves that the guides and information on e-learning have met the requirements for clarity and ease of understanding e-learning. The content / material component of e-learning has an average k value of 0.89, including the very high category. This value proves that the content on e-learning developed is in accordance with the demands of KD according to the 2013 revision of the 2018 curriculum. The aspect of content feasibility includes the suitability of the material contained in content with KI, KD and the learning objectives provided depend on students' abilities[25]. The average k value of the evaluation section is 0.86 which is categorized as very high. In general, evaluation is a systematic process, which determines the value of something based on certain criteria through evaluation[46,47]. With this average value, it shows that the evaluation of e-learning can measure the abilities of students.

Next is construct validation. The assessment was carried out by three chemistry teachers. The first component construct validation is a guide and information. The mean value of k is 0.83, including the very high category. This value proves that e-learning has conveyed information that is clear and easy to understand. The k average score of the program performance components is 0.89, including in the very high category. This section covers program installation, user-friendliness and consistency in e-learning. The last component, namely systematics, aesthetics and design principles, received an average k value of 0.90, including the very high validity category. E-learning that is made interesting can motivate

students to read learning material[27]. This is also supported by previous research [48,49].

The results obtained from the validator's assessment were then made several revisions to the e-learning content which was developed based on the suggestions of the validator.

#### 2) *Revision*

The revision stage is intended to be able to increase the part of e-learning content for the development of atomic theory using the Moodle application developed which is considered inappropriate before being tested. After the revision is made, then it is given to the validator to be discussed again. The revision is complete if the e-learning content for the development of atomic theory using the Moodle application has been declared valid by the validator.

From the data analysis that has been carried out regarding PjBL based e-learning with the flipped classroom approach on the material of atomic theory development using the Moodle application, practical results are obtained of 0.83 with a very high category. This shows that e-learning with the flipped classroom approach on the development of atomic theory uses the practical Moodle application for use in chemistry learning. It is hoped that this valid and practical PjBL-based e-learning media can increase the creativity of students supported by previous research[50].

#### **IV. CONCLUSION**

Based on the data analysis that has been done, the e-learning content for the development of atomic theory using the Moodle application produced in this development research has content and construct validity levels of 0.89 and 0.87 respectively with very high categories and a level of practicality. amounting to 0.83 in the very high category. So it can be concluded that the content of e-learning for the development of atomic theory using the Moodle application on the material for the development of atomic theory is valid and practical. As well as the products produced in this study in the form of e-learning learning content for material on atomic theory development using the Moodle application on material for atomic theory



development can already be used by SMA / MA schools.

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